

**FINAL  
ENVIRONMENTAL ASSESSMENT**

**RE-ESTABLISHMENT OF THE TARAHUMARA FROG, SYCAMORE  
AND BIG CASA BLANCA CANYONS, SANTA CRUZ COUNTY,  
ARIZONA**



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## **Section I: PURPOSE AND NEED FOR ACTION**

### **A. Purpose of the Proposed Action:**

The purpose of the proposed action is to conserve the Tarahumara frog (*Rana tarahumarae*). Conservation would reduce threats to the species and minimize the likelihood that it would need protection under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (ESA). Our ability to effectively conserve and manage this species is limited because it has been extirpated from Arizona and the United States since 1983. This action would be undertaken cooperatively by the Arizona Ecological Services Office of the U.S. Fish and Wildlife Service (AESO) and the Arizona Game and Fish Department (AGFD), in coordination with the Tarahumara Frog Conservation Team (TFCT). The TFCT, which was first convened in 1991, consists of representatives from AGFD, AESO, Coronado National Forest, Arizona-Sonora Desert Museum, U.S. Geological Survey - Biological Resources Division, Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES), University of Arizona, and other interested parties. Both the AGFD and AESO have an interest in re-establishing species extirpated from Arizona.

### **B. Need for Taking the Proposed Action:**

Conservation through re-establishment of the Tarahumara frog in Arizona is consistent with the Arizona Game and Fish Department's Wildlife 2006 Nongame and Endangered Wildlife subprogram narrative, a goal of which is restoration of native biological diversity and recovery of imperiled species. Additional documents, such as work plans and job descriptions for the State of Arizona's Heritage Program and the ESA Section 6 Agreement between the Fish and Wildlife Service and AGFD, the Ranid Frog Section 6 Project, under that agreement, and a contract from the Fish and Wildlife Service to AGFD to conserve the Tarahumara frog, support similar objectives. Furthermore, through a June 2002 Memorandum of Agreement, the Fish and Wildlife Service and AGFD have mutually agreed to participate in actions to improve the status of wildlife species-at-risk, such as the Tarahumara frog. The Coronado National Forest Land and Resource Management Plan (LRMP 1986) has, among others, a goal of maintaining populations of all native wildlife, including the Tarahumara frog. A 1990 "Arizona Wildlife and Fisheries Comprehensive Plan" signed by the AGFD Director and the Forest Service's Regional Director has the same goal and calls for cooperative recovery efforts for the Tarahumara frog. Re-establishment of the species in Arizona is expected to reduce any future need to list the species as threatened or endangered under the ESA.

### **C. Decision to be Made by the Responsible Official:**

Our decision is whether the Fish and Wildlife Service will, in cooperation with AGFD and others, 1) pursue proposed re-establishment of the Tarahumara frog in Big Casa Blanca and Sycamore canyons of the Coronado National Forest, Santa Cruz County, Arizona (Figure 1), or 2) take no action on re-establishment of this species. A 30-day review period was provided for the public to

submit comments on the draft of this EA (see “Issues Raised During Project Planning or Public Scoping” below). Our decision will occur after consideration of all public comments received during the comment period. If the alternative selected would cause significant adverse impacts on the human or natural environment, an Environmental Impact Statement will be prepared prior to implementing that alternative. If no significant adverse impacts are anticipated, we will prepare a Finding of No Significant Impact. These documents will be posted on our website (<http://arizonaes@fws.gov>) and mailed to those who provided comments on the draft EA or who request copies.

Through a State process described in “Procedures for Nongame Wildlife and Endangered Species Re-establishment Projects” (Johnson and Glinski 1989), AGFD will also decide whether or not to proceed with re-establishment. As of this writing, a decision by AGFD was pending.

## **Section II: PUBLIC INVOLVEMENT**

The draft EA was sent on September 12, 2003 to 26 persons, agencies, and government officials for review, was announced and made available for public review on our office website (<http://arizonaes@fws.gov>) on September 15, 2003, and was announced via a news release faxed on September 15, 2003 to 35 newspapers, as well as several television and radio stations and publishers of other printed materials. An article about the proposed re-establishment was published on September 17, 2003 in the Arizona Daily Star, a Tucson newspaper, which included information about how the public could comment. Articles describing the proposal were also published in AZCENTRAL, an online Arizona news outlet, on September 19, 2003; in the Provo, Utah Daily Herald on September 20, 2003; in HerpDigest, an online journal, on September 28, 2003; and in the fall issue of Sky Island Alliance’s newsletter. The public comment period was from September 15 to October 15, 2003. Development of the draft and final environmental assessments was also coordinated with the Arizona Game and Fish Department’s Nongame Branch, Phoenix, Arizona, and the Coronado National Forest, Nogales Ranger District, Nogales, Arizona. In addition to serving as NEPA compliance for our agency, the final EA is part of AGFD’s “Procedures for Nongame Wildlife and Endangered Species Re-establishment Projects”.

### **D. Issues Raised During Project Planning or Public Scoping:**

#### **Comments and Responses on the Draft EA**

During the public comment period on the draft EA, seven comment letters were received. Questions, issues, and concerns raised in each letter and how we addressed each in this final EA are described below.

Comment Letter #1:

Comment a. Do we plan to use “conazole” to sterilize the frogs of chytrid before reintroduction? Is there a protocol in place with regards to ridding animals of disease before releasing them into new areas?

Response. A pre-release health screening has been developed by the Phoenix Zoo and will be used to screen Tarahumara frogs for diseases prior to release. This will minimize the likelihood that disease or parasites will be introduced via Tarahumara frog re-establishment. Treatment with itraconazole, a fungicide, is a standard and effective treatment to clear frogs of chytridiomycosis. This will be one of the options considered during the health screening. Veterinarians at the Phoenix Zoo and the Arizona-Sonora Desert Museum (ASDM) in Tucson will be consulted as to the most effective means to ensure chytridiomycosis is not introduced to field sites with the frogs. In addition, all of our field work shall conform to amphibian disease prevention protocols to further minimize the likelihood of disease transmission (see “Conservation Measures”, pages 12-13).

Comment b. Are any bullfrogs breeding within two miles of your re-establishment sites?

Response. The relevance of this comment has to do with the ability of bullfrogs to eliminate populations of native frogs through predation, and or competition, and their ability to move across the landscape from one water source to another. Bullfrogs can also be carriers of chytridiomycosis or other diseases. We are not aware of bullfrogs in the Big Casa Blanca Canyon area, and we do not consider them an immediate threat there. Bullfrogs have, on occasion, been found in Sycamore Canyon, and we are investigating a report of many young bullfrogs recently seen in that canyon. Bullfrogs are typically found and do well in relatively deep, perennial pools. Pools exist in Sycamore Canyon that could probably support breeding populations of bullfrogs. On the other hand, much of the canyon is characterized by a shallow stream and intermittent flows, which provide poor habitat for bullfrogs. Periodic flood flows through the canyon may eliminate or limit bullfrog populations, as well. Bullfrogs have existed at stock tanks within a few miles of Sycamore Canyon for many years without the species becoming established in Sycamore Canyon. However, we will monitor the situation and will not release Tarahumara frogs in areas where bullfrogs are abundant. We will attempt to eliminate bullfrogs that are found at the release sites. We have modified the EA per this comment (addition of Conservation Measure #8, page 13).

## Comment Letter #2

Comment a. I support the re-establishment 100%.

Response. Comment noted.

Comment b. On page 19, in the first full paragraph, a 534% increase in the frequency of contact vocalizations by female Mexican spotted (*Strix occidentalis lucida*) owls is noted. The number seems quite high compared to the 58% increase by male owls.

Response. We rechecked the citation for this information (Swarthout and Steidl 2003) and found we had cited it incorrectly. In the study, hikers caused male and female Mexican spotted owls to increase contact vocalizations by 534% and 58%, respectively (we interposed these figures in the draft). We have corrected the text.

Comment c. Based on Mexican spotted owl inventory and monitoring projects in the Huachuca Mountains of Fort Huachuca, it may not be completely necessary to avoid Mexican spotted owl protected activity centers (PACs) all together, as mentioned on page 19 in the second paragraph. I do agree with the 0.25-mile radius buffer around nests during the breeding season. However, hiking, releasing, and monitoring activities associated with T-frog reintroductions in PACs shouldn't have much of an impact on the Mexican spotted owl, especially if personnel are not going out of their way to look for and harass owls. I have observed increased activity by undocumented immigrants and drug smugglers in several canyons that are both easily accessed and fairly remote. Despite frequent immigrant and drug smuggling activity (walking, eating, etc.) occurring within 20 feet of an active nest in fairly remote canyons, Mexican spotted owl reproduction has been successful on several occasions. If the Tarahumara frog personnel simply do their required job and get out, thus minimizing their time in PACs, PACs shouldn't be a limiting factor in the reintroduction process.

Response. We appreciate these observations and agree that the likelihood that Mexican spotted owls will be significantly adversely affected by Tarahumara frog monitoring or releases is relatively low. Your observations and the work by Swarthout and Steidl (2001, 2003) suggest that disturbance of owls becomes biologically significant only at relatively high use levels. Swarthout and Steidl (2003) suggest that restrictions on hiking intensity near nests should be considered on a case-by-case basis, but should probably only be implemented in canyons with use levels approximating or exceeding the use in their study (>48 hiking groups per day). We have proposed to not conduct monitoring or release activities within 1/4 mile of a nest during the breeding season; however, we will not always know the locations of nests. In any case, we do not expect Tarahumara frog activities to exceed 10 groups of hikers per day through a canyon during the nesting season, which would only occur during releases. Based on Swarthout and Steidl's work, these levels of activity should cause minimal disturbance to nesting owls. Sycamore Canyon can receive considerable visitation by recreationists, smugglers, and undocumented immigrants. In this canyon, cumulative human visitation would be something more than 10 groups of hikers, but we do not know if it might exceed the 48 hiking groups suggested as an upper limit by Swarthout and Steidl (2003). The only restrictions we have imposed on Tarahumara frog release and monitoring activities are to not conduct such activities within 0.25 mile of a known nest and to not camp within a PAC. We do not believe these measures compromise our ability to re-establish the Tarahumara frog, but they are reasonable measures to protect the Mexican spotted owl.

Comment d. One possibility that could help expedite the reintroduction process, given my previous comment, would be to begin the release monitoring process without consequence before the breeding/survey season for Mexican spotted owl begins. Once the breeding/survey season

begins, monitoring the PACs with the intent of determining the occupancy and breeding status of the PAC and, hopefully, locating any nests would prove beneficial. If nests are located, then the 0.25-mile radius buffer can be established. If owls in the PAC successfully reproduce and fledge young, then the 0.25-mile buffer should include the roosting grove of the fledgling(s) and adult(s). Having a biologist familiar with owls accompany frog personnel could prove beneficial. Ideally, someone familiar with both the owl and the frog would be the best scenario. If the PAC is determined to be unoccupied or a “non-nesting” status is determined, then the reintroduction could proceed as originally planned without consequence.

Response. In Arizona, Mexican spotted owls typically begin breeding activities in March, young fledge in June, and the parents feed the young through August, but sometimes into September or early October. The first release of Tarahumara frogs would probably take place either in March or April 2004. These first releases may occur outside, or at the beginning of, the breeding season. Often the timing of releases will depend on the availability of late stage tadpoles or metamorph frogs, which, based on breeding chronology and time to metamorphosis in captivity, will most likely be late summer or fall. Thus, future releases would most likely occur either at the end or outside of the owl breeding season. However, monitoring needs to occur throughout the year to properly track the status of the releases. As we have discussed in the Environmental Consequences, monitoring or release activities could occur near an active nest, if the nest was not detected during annual surveys. We would consult with the Coronado National Forest biologists about the status and most recent surveys for Mexican spotted owls before conducting release and monitoring activities. Coronado National Forest biologists familiar with both the PACs and nesting biology of the owl, as well as the Tarahumara frog re-establishment program, would be involved in the project and would be consulted about the best ways to avoid impacts to Mexican spotted owls.

Comment Letter #3:

Comment a. On page 19, in the first full paragraph, the frequency of contact vocalizations by female Mexican spotted owls should be 58%, and the same figure for males should be 534%.

Response. We have corrected the text.

Comment Letter #4:

Comment a. We support the proposed action to release Tarahumara frogs into Sycamore and Big Casa Blanca canyons in Santa Cruz County, Arizona.

Response. Comment noted.

Comment b. The draft EA presents only one alternative to no action. We wonder if the agency considered a more aggressive re-establishment proposal or examined other potential release sites as part of this analysis under the National Environmental Policy Act (NEPA).

Response. The choice of release sites flowed from the recommendations of the TFCT and the investigations of Steve Hale and others (Hale 1992; Hale and Jarchow 1988, Hale and May 1983). The Tarahumara frog is only known from six locations in Arizona. Big Casa Blanca and Sycamore canyons were the best habitats for the frog. Two of the four remaining sites, Gardner and Adobe canyons, are adjacent to Big Casa Blanca Canyon. We believe that if re-establishment is successful in Big Casa Blanca Canyon, the frogs could disperse to Gardner Canyon. The habitat in Adobe Canyon is marginal but again, frogs could potentially colonize this canyon from Big Casa Blanca Canyon. In the Pajarito-Atascosa-Tumacacori range, Tarahumara frogs were known from Sycamore Canyon (and the first 0.6 mile of Penasco Canyon upstream of its confluence with Sycamore Canyon), Pena Blanca/Alamo Canyon, and Tinaja Canyon. Hale (1992) reports that sites in Pena Blanca/Alamo Canyon are no longer suitable habitat for Tarahumara frogs due to inundation by Pena Blanca Lake at one site and siltation and filling of bedrock pools at the other. Only a single tinaja with permanent water exists in Tinaja Canyon, providing limited habitat for Tarahumara frogs. If we are unsuccessful in re-establishing Tarahumara frogs at Big Casa Blanca or Sycamore canyons, our options for other sites are very limited. However, if we are not successful with this proposal, we will coordinate through the TFCT to explore other options and if feasible, we will develop another proposal, including NEPA, ESA, and other compliance, as appropriate.

Comment c. It appears the ranching interests were given a greater voice in whether or not this re-establishment will proceed than were other members of the public. The April 17 meeting (pg. 14 of the draft EA) held in Nogales among landowners and grazing permittees, begs the question: why was a similar stakeholder meeting not held for conservation entities or other interests focused on habitat and species recovery?

Response. Scoping by the AGFD revealed that many comments and concerns were being voiced by the ranching community about the implications of this release on future livestock grazing. AGFD strives to obtain concurrence from landowners and lessees in the area of proposed re-establishment projects. Because of this, we believed meetings with the landowners and grazing permittees were needed. The public, including ranching interests, were provided opportunity to comment on the draft EA during a 30-day comment period, and during two 30-day comment periods on a draft and revised draft proposal authored by AGFD.

Comment d. The EA somewhat oddly states its purpose on page 2 as “reduce threats to the species and minimize the likelihood that it (the frog) would need protection under the ESA.” The Fish and Wildlife Service is charged with an important public trust responsibility relative to endangered species. That should be taken seriously. We do not believe that avoiding the ESA is an appropriate goal for the key agency charged with implementing it.

Response. Halting or mitigating the decline of species tending towards listing is a high priority for the Fish and Wildlife Service. Often by the time the status of a species declines to the point that listing is warranted, recovery and alleviating threats is a long and expensive proposition. Preventing or mitigating the decline of species before they warrant listing is typically a much more

efficient way to conserve species. As a result, we have entered into agreements with AGFD and other agencies to track the status of and conserve species tending towards listing, such as the Tarahumara frog. If, at any time in the future, threats to the Tarahumara frog indicate listing as a threatened or endangered species is warranted, regardless of the success or failure of this re-establishment project, we will designate the frog a candidate for listing and assign it a listing priority.

Comment e. The draft EA notes “Any trespass cattle observed in the Goodding Research Area (Sycamore Canyon) will be promptly reported to the Nogales Ranger District of the Coronado National Forest.” This is an appropriate action, as far as it goes, but we suggest you also consider follow up with the Forest Service to make sure the cattle are removed.

Response. The Coronado National Forest has a policy of removing trespass cattle from enclosures as soon as possible after such cattle have been detected. However, if on subsequent visits, we find the cattle yet to be removed, we will remind the Nogales Ranger District of their presence in the enclosure. We have modified the conservation measures in response to this comment (see pages 12-13).

Comment f. We support the proposal on page 19 that “No monitoring or releases would be conducted within 0.25 mile of any (Mexican spotted owl) nest during the nesting season.” This should limit disturbance to the owls during a time when females might be dissuaded from feeding young as actively.

Response. Comment noted.

Comment g. Because disease and toxicity may have been two major factors leading to the extirpation of the Tarahumara frog, we support the screening of the frogs prior to release and also screening the habitat. Also, if toxicity due to heavy metals was a possible reason for the extirpation of the species previously, it seems important to make sure continuing toxicity is no longer a threat. Efforts to limit the species exposure to these heavy metals should be implemented.

Response. As discussed in our response to comment letter #1, comment a, and as described in our conservation measures (pages 12-13, herein), measures will be taken to ensure that diseased frogs are not released and that the likelihood of disease transmission from other means are minimized. A likely cause of elevated cadmium to zinc ratios noted by Hale and Jarchow (1988) in Sycamore Canyon was airborne pollutants from copper smelters. These smelters are now either closed (Douglas, AZ and Cananea, Sonora) or have scrubbers installed on the stacks (Nacozari, Sonora). As a result, we expect that toxicity problems have likely abated. We are not aware of other significant potential sources of toxicity at the release sites. If, in the future, mining or other activities with potential toxic effects were proposed in these canyons, the Forest Service would evaluate the impacts of these activities in accordance with NEPA and implement appropriate mitigation, as needed (see “Mining and Fire Management”, pages 21-22).



Comment h. According to the draft EA, “no listed species were likely affected in any way by the presence of the frogs historically.” We ask that you reevaluate this statement or modify it to read “the species had no adverse impacts on the ecosystem and we do not expect for any to occur in the future due to it being reintroduced back into this small part of its historical range.” Our reason for this point is that by virtue of being part of the ecosystem, no species is without some impact.

Response. We agree. We have revised the text as suggested.

#### Comment Letter #5

Comment a. We support the proposed alternative to re-establish the Tarahumara frog into Sycamore Canyon and Big Casa Blanca Canyon, Santa Cruz County, Arizona.

Response. Comment noted.

Comment b. The TFCT, Fish and Wildlife Service, AGFD, and the Coronado National Forest should consider funding more research on, and monitoring and management of, Tarahumara frogs in Mexico in conjunction with Mexican research institutions.

Response. We agree. In 2000 and 2001, we funded Steve Hale and IMADES to conduct status surveys for the Tarahumara frog in Sonora. These surveys provided valuable information on the current status of the species (see “Biology and Status of the Tarahumara frog”, herein). We will continue to seek funding and resources to work with IMADES and other entities in Sonora on the status and conservation of the Tarahumara frog.

Comment c. Interpretive signing should be developed in conjunction with the Fish and Wildlife Service, AGFD, and the Coronado National Forest, and placed in Sycamore Canyon to discourage people and pets from swimming, wading, and playing in the pools to protect both Tarahumara frogs and Chiricahua leopard frogs.

Response. The best habitats for Tarahumara frogs are deep plunge pools, which are also areas favored by bathers. Chiricahua leopard frogs are likely to be found in the same habitats, as well. The greatest danger of people recreating in frog habitats is the potential to spread non-native species or chytridiomycosis into the habitats. However, chytridiomycosis is already present in Sycamore Canyon and the Coronado National Forest has already posted signs at the Sycamore Canyon parking area alerting people that the area is closed to fishing. When bathers and swimmers approach a pool with Tarahumara or Chiricahua leopard frogs, these frogs are likely to jump into the pool and stay submerged or stay at the pool’s edge away from people. They would resume their normal activities when the people left. We do not expect these activities to be frequent at any one pool, and pools deeper into the canyon are likely to receive little or no use. As we discussed in the “Description of Re-establishments Sites, Sycamore Canyon” (page 18), about 90 percent of recreational use in Sycamore Canyon is birding, rather than swimming or

bathing. As a result, we do not believe limitations on swimming or bathing are warranted at this time. During monitoring of Tarahumara frogs we will monitor recreational impacts.

Comment d. Proactive and contingency management planning should be instituted in the case of either Big Casa Blanca Canyon or Sycamore Canyon being invaded by bullfrogs.

Response. As we discussed in our response to Comment Letter #1, comment b, large numbers of small bullfrogs have recently been reported from Sycamore Canyon. We have discussed with AGFD organizing an effort to physically remove the bullfrogs. We and others have strived to eliminate bullfrogs as they show up in Sycamore Canyon, and we will continue this policy both at Sycamore Canyon and Big Casa Blanca Canyon, to the best of our ability. Conservation measure #8 has been added in response to this and previous comments on this topic.

#### Comment Letter #6

Comment a. On page 13 of the draft EA under “Section IV”, line 17, should it be Pajarita or Pajarito Wilderness?

Response. Maps available to us refer to the “Pajarito” Mountains, where Sycamore Canyon is located. However, the Coronado National Forest map refers to the “Pajarita” Wilderness, which overlays Sycamore Canyon. Staff at the Nogales Ranger District confirm that the proper name for the wilderness area is “Pajarita Wilderness”.

#### Comment Letter #7

Comment a. Whatever perceptions might be by some ranchers regarding the potential impacts of the re-establishment effort, this frog must be considered to offer no realistically viewed danger of economic harm. Anyone who tries to construct a reasonable argument for such harm would quickly find themselves in the bind of claiming that adding to ecosystems wealth in the broadest sense detracts from ecosystem value because healthy ecosystems cannot be usefully exploited.

Response. We agree that this proposed re-establishment will have minimal economic impact and, in fact, some benefits are likely to accrue (see “Economics” under “Environmental Consequences”, pages 22-23).

In the draft EA we also summarized comments received by AGFD on their first and second public review drafts of the proposal to re-establish the Tarahumara frog in Arizona. We will not repeat those comments here. However, the issues and impacts discussed herein, and the conservation measures proposed as part of the proposed action, were derived in part from those comments. Expanded discussion of comment letters and issues therein can be found in AGFD’s proposal to re-establish the Tarahumara frog (Field *et al.* 2003 and a subsequent draft that is in preparation, M. Sredl, pers. comm. 2003). We have considered all of the comments, both on the draft EA and

AGFD's first and second draft proposals, in the development of this final environmental assessment.

### **Section III: ALTERNATIVES INCLUDING THE PROPOSED ACTION**

#### **No Action Alternative**

Under the No Action Alternative, the Fish and Wildlife Service would not implement proposed re-establishment of the Tarahumara frog in the Big Casa Blanca and Sycamore canyon areas of the Coronado National Forest. AGFD, acting under their authorities, may independently decide to pursue re-establishment, but it would be without the participation of the Fish and Wildlife Service.

#### **Proposed Alternative**

Under this alternative, the Fish and Wildlife Service would, in cooperation with AGFD, the TFCT, and others, pursue re-establishment of the Tarahumara frog in the Big Casa Blanca and Sycamore canyon areas, according to the procedures and schedules detailed in AGFD's proposal to re-establish the frog at these sites (Field *et al.* 2003). Re-establishment would be contingent upon completion of AGFD's "Procedures for Nongame Wildlife and Endangered Species Re-establishment Projects" and approval by the Arizona Game and Fish Commission (Johnson and Glinski 1989).

To summarize from AGFD's re-establishment proposal, the proposal calls for a cooperative effort among the participants of the TFCT to: 1) obtain stock of Tarahumara frogs from Sonora, 2) re-establish populations of the frog from imported stock into Big Casa Blanca Canyon, Santa Rita Mountains, and Sycamore Canyon, Pajarito Mountains, 3) monitor the releases and adapt management as needed to ensure the re-establishment is successful, and 4) continue coordination through the TFCT to ensure all issues and concerns are addressed. These four primary elements of the plan, and conservation measures to protect threatened and endangered species and their habitats, are described briefly here (please refer to Field *et al.* 2003 for additional detail):

#### Obtain Stock from Sonora

A portion of an egg mass was collected by S. Hale in May 2000 from the Sierra la Madera in northern Sonora, which is the closest known Tarahumara frog population to Arizona. These eggs were hatched and reared, or headstarted into frogs (Rorabaugh and Humphrey 2002). Tarahumara frogs from this egg mass are now housed at the ASDM, San Bernardino and Kofa National Wildlife Refuges, and other locales. We funded in part the construction of substantial breeding/propagation facilities at the ASDM. The frogs are now breeding in these facilities and at San Bernardino and Kofa NWRs. These frogs would be the basis for initial experimental re-establishment of the species to Arizona. Additional collections and importation of Tarahumara frogs would be needed to diversify the genetic stock. We are working with our partners at the Instituto del Medio y El Desarrollo Sustentable del Estado de Sonora (IMADES) in Hermosillo,

Sonora to arrange additional importation of frogs. Only a small number of tadpoles, frogs, and/or portions of egg masses would be collected from any one site in Mexico, and we would focus on collecting and headstarting eggs.

### Release Frogs

Initial releases would occur at Big Casa Blanca Canyon in suitable microsites. Once established there, re-establishment would be considered at Sycamore Canyon (see Figure 1). These two sites were the stronghold of the species before its extirpation in 1983. Habitats are still intact in these canyons, and we believe they may be the best sites for re-establishment. The species appears to be quite sensitive to chytridiomycosis, a fungal disease (Rollins-Smith *et al.* 2002), and chytrids are known to be present in Chiricahua leopard frogs in Sycamore Canyon. No ranid frogs are currently known from Big Casa Blanca Canyon (although Chiricahua leopard frogs occurred there historically and Canyon treefrogs occur there now) and chytrids have not been documented in the Santa Rita Mountains. In addition, large numbers of juvenile bullfrogs have recently been reported from Sycamore Canyon; however, bullfrogs have never been reported from Big Casa Blanca Canyon. Bullfrogs prey upon and compete with native frogs. Because of these potential complications, Big Casa Blanca Canyon is the first choice for re-establishment, and we believe it is our best chance for success. We will not attempt to re-establish Tarahumara frogs in habitats where bullfrogs have become established and are in abundance. If approved by AGFD, releases could begin in spring of 2004.

### Monitoring and Adaptive Management

Both dynamics of Tarahumara frog populations and the quality of habitats to which they were released would be monitored. Establishment and subsequent reproduction of the founding population should be monitored over at least a 3 year period. Visual encounter surveys would be conducted to monitor frogs, and released frogs would be marked, either by toe-clipping or passive integrated transponders (PIT) tagging, to better track the status and success of the releases. Frogs would be monitored every other day for the first week following release, then weekly during the first month, and once a month thereafter. The habitats of the release sites would also be monitored. These monitoring data would be used to adjust management, subsequent releases, and release/monitoring protocols to maximize the likelihood of success. Additional monitoring protocols are detailed in Figure 2 of Field *et al.* (2003).

### Continued Coordination through the TFCT

All aspects of the re-establishment program would be coordinated through the TFCT, which would meet a minimum of twice annually. The diverse backgrounds and expertise within the TFCT make the team's input essential to the success of the project. Especially important would be TFCT input in regard to analysis of monitoring data and recommendations for adaptive management.

## Conservation Measures

The following measures would be implemented as part of the proposed action:

1. No release or monitoring activities would occur within 0.25 mile of any active Mexican spotted owl nest during the breeding season (March 1-August 31).
2. No camping would occur within Mexican spotted owl PACs.
3. To minimize fire risk, no camp fires will occur during any backcountry camping needed during releases or monitoring. Field workers will not smoke while conducting field work.
4. All monitoring work that may result in dip-netting or other forms of take of Chiricahua leopard frogs or Sonora chub will be conducted under Fish and Wildlife Service and Arizona Game and Fish Department permits, and will conform to all conditions of those permits. Any Sonora chub or Chiricahua leopard frogs unintentionally dip-netted will promptly be returned to the water unharmed.
5. Any trespass cattle observed in the Goodding Research Natural Area (Sycamore Canyon) livestock enclosure will be promptly reported to the Nogales Ranger District of the Coronado National Forest. If on subsequent visits, we find the cattle still present, we will remind the Nogales Ranger District of their presence in the enclosure.
6. All field work shall conform to amphibian disease prevention protocols in the survey protocol for the Chiricahua leopard frog.
7. A pre-release health screening is being developed by the Phoenix Zoo and will be used to screen Tarahumara frogs for diseases prior to release. This will minimize the likelihood that disease or parasites will be introduced via Tarahumara frog re-establishment.
8. We shall attempt to eliminate bullfrogs that are found at Big Casa Blanca and Sycamore Canyons. Tarahumara frogs will not be released to sites where bullfrogs occur in abundance.

## **Section IV: AFFECTED ENVIRONMENT**

### **Biology and Status of the Tarahumara frog**

The Tarahumara frog is a medium-sized (adults range from 2.6 to 4.5 inches in snout-urostyle length), drab green-brown frog with small brown to black spots on the body and dark crossbars on the legs. The hind feet are extensively webbed. This species lacks a distinct dorsolateral fold, characteristic of related leopard frogs. Larvae are greenish-yellow with small dark spots over the dorsum and larger spots on the tail. Larvae grow as large as 3.8 inches prior to metamorphosis. Both sexes, and adults and juveniles, have a call consisting of snores of 0.5-1.5 second in duration, as well as occasional “ceps”, “phoots”, and other sounds (Rorabaugh, pers. obs.).

Rorabaugh and Hale (in press) reviewed the biology, status, and reasons for decline of the Tarahumara frog. Much of the following discussion is taken from that manuscript. Tarahumara frogs (*Rana tarahumarae*) are known from 63 localities in montane canyons in extreme southern Arizona south to northern Sinaloa and southwestern Chihuahua, Mexico (Campbell 1931, Zweifel 1968, Hale *et al.* 1977, 1995, Hale 2001). The range of Tarahumara frogs is centered in the

northern Sierra Madre Occidental of Mexico (McCranie and Wilson 1987); however, the eastern and southern distributional limits are not clear. Tarahumara frogs may not occur south of the Sierra Surutato in Sinaloa.

In the United States, Tarahumara frogs were known historically from six locales, including three from the Santa Rita Mountains and three from the Atascosa-Pajarito-Tumacacori Mountains complex, which are located north and west, respectively, of Nogales in Santa Cruz County, Arizona (Campbell 1931, Zweifel 1968; Hale *et al.* 1977, 1995). Tarahumara frogs have been extirpated from all localities in Arizona. The last observation of Tarahumara frogs in Arizona, and thus in the U.S., was in May 1983 in Big Casa Blanca Canyon in the Santa Rita Mountains. Surveys from May 1998–May 2000 in Sonora yielded Tarahumara frogs at six of 11 historical localities and three new localities (Hale *et al.* 1998, Hale 2001).

Breeding habitat is located within oak and pine-oak woodland and the Pacific coast tropical area (foothill thornscrub and tropical deciduous forest; Hale and May 1983, McCranie and Wilson 1987). Breeding occurs primarily towards the end of the dry season (April–May), when permanent water is often restricted to springs and “plunge pools” (deep [ $> 3$  feet] pools in bedrock or among boulders) with deep underwater and streamside retreats. Plunge pools in canyons with low mean flows ( $< 0.2$  cubic feet per second) and relatively steep gradients ( $> 200$  feet per 0.6 mile of stream) provide the best breeding sites (Hale and May 1983; Hale 2001). Permanent water is necessary for metamorphosis. At Pena Blanca Spring and Tinaja Canyon, Arizona, and Arroyo El Salto, northeastern Sonora, Tarahumara frogs inhabited artificial impoundments (Hale and May 1983, Hale 2001). The presence of hibernacula where frogs can remain moist and protected from predators and freezing temperatures is an important habitat feature (Hale and May 1983), particularly in the northern portion of the species’ range or at higher elevation sites. Hibernacula may include moist refugia among rocks and boulders along streams and at plunge pools. Frogs likely also spend the cooler months at the bottom of ponds.

Hale and Jarchow (1988) list the following possible causal mechanisms in the extirpation of Tarahumara frog populations: 1) winter cold; 2) flooding or severe drought; 3) competition; 4) predation; 5) disease; and 6) heavy metal poisoning. Metals occur naturally in streamside deposits and may be mobilized by acid precipitation events. Acidic rainfall in southeastern Arizona and northern Sonora may have occurred as a result of atmospheric emissions from copper smelters at Cananea and Nacozari, northeastern Sonora, and Douglas, Arizona (Blanchard and Stromberg 1987, Hale *et al.* 1995). Cadmium toxicity is a possible cause of observed Tarahumara frog die-offs in Arroyo La Carabina, Arroyo Pinos Altos, and Arroyo La Colonia in northeastern Sonora, and Big Casa Blanca and Sycamore canyons in Arizona (Hale and Jarchow 1988, Hale *et al.* 1998.) Cadmium is highly toxic due to its propensity to substitute for zinc and/or copper in enzymes (Coombs 1979). Absorption through the skin or ingestion of zinc by frogs may act to reduce cadmium toxicity. Thus in areas of relatively high zinc to cadmium ratios, frogs may be less affected (Hale and Jarchow 1988, Hale *et al.* 1998). The solubility of zinc in weak acids may account for its depletion from decades of acidic precipitation on rhyolitic stream banks. Elevated levels of cadmium occur in and near tailings of copper, lead, and zinc mines (Peterson and

Alloway 1979). Cumulative sedimentation from physical erosion and deposition in drainages likely result in elevated concentrations of cadmium in downstream reaches. Thus, stream headwaters and springs may be important refuges for frogs when toxic conditions exist in downstream reaches (Hale *et al.* 1998.) Die-offs of ranid frogs (Tarahumara frogs, lowland leopard frogs, and Chiricahua leopard frogs) in Sycamore Canyon, Arizona are similar to die-offs of Chiricahua leopard frogs reported by Scott (1993) in New Mexico. Scott attributed the New Mexico events to “postmetamorphic death syndrome.” The die-offs are also consistent with chytridiomycosis, a fungal disease implicated in declines of anurans in Australia and Central America (Berger *et al.* 1998) and elsewhere. Tarahumara frogs collected during a die-off in Sycamore Canyon in 1974 were infected with chytridiomycosis (T.R. Jones and P.J. Fernandez, personal communication). Chytrids are still present in Sycamore Canyon and are associated with periodic die-offs of Chiricahua leopard frogs in that system. Chytridiomycosis was also confirmed from frogs collected in northeastern and eastcentral Sonora at Arroyo La Carabina (1981, 1982), Arroyo el Tigre (1999), Arroyo La Colonia (1982), Arroyo el Trigo (1982), and Arroyo el Aguaje (1999, Hale 2001). Tarahumara frogs are extirpated from Sycamore Canyon, Arroyo La Carabina, and Arroyo La Colonia; however, they have persisted at Arroyo el Trigo despite the presence of chytridiomycosis. As well, Hale (2001) presents evidence of population persistence despite chytridiomycosis at Arroyo El Aguaje, Arroyo La Colonia, and Arroyo El Cobre.

Tarahumara frogs may be excluded from habitats that support large populations of nonnative predators, such as American bullfrogs and fishes (e.g., green sunfish [*Lepomis cyanellus*], largemouth bass [*Micropterus salmoides*]; Hale and May 1983). Hale (2001) suggested predation by a large chub species (*Gila* sp.) may have eliminated Tarahumara frogs from two sites in Sonora.

Tarahumara frogs are included on a draft state list of species of concern (Arizona Game and Fish Department 1996). Tarahumara frogs currently have no status under the Federal ESA, CITES, or Mexican law. However, under the ESA, the frog was a category 2 candidate from 1982-1985, a category 1 candidate from 1985-1994, and then was reclassified again as category 2 from 1994-1996. Since 1996, the Tarahumara frog has had no status under the ESA.

## **Description of Re-establishments Sites**

### **Big Casa Blanca Canyon Area**

During a study of the Tarahumara frog from 1974-1977 (Hale and May 1983), the species was commonly found in Big Casa Blanca Canyon from 4890 to 5610 feet elevation, and occasionally from elevation 6400 to 6790 feet, and as low as 4660 feet. Frogs were also found occasionally from 4890 to 5090 feet elevation in Walker Canyon, a tributary to Big Casa Blanca Canyon. If

re-establishment is successful, Tarahumara frogs would be expected to occupy all of these reaches. In August 1974, Tarahumara frogs were found at a bedrock plunge pool in Adobe Canyon, which is to the east and north of Big Casa Blanca Canyon. However, they were not located there again, and Hale and May (1983) considered the habitat quality there too poor to support a permanent population; habitat may have degraded further since then. To the north of Adobe Canyon is Gardner Canyon, which supports poor to moderate plunge pool Tarahumara frog habitat. Until 1977, Tarahumara frogs were occasionally observed or collected from 5800 to 6460 feet (Hale and May 1983) in that canyon above Tunnel Spring. If successfully re-established in Big Casa Blanca Canyon, Tarahumara frogs could potentially disperse to this reach of Gardner Canyon. All former habitats of the Tarahumara frog in the Big Casa Blanca Canyon area are on lands managed by the Coronado National Forest.

The Big Casa Blanca Canyon area is accessed by Forest Road 785 that traverses Gardner Canyon and ends near the Mount Wrightson Wilderness boundary. A trail leads from Tunnel Spring in Gardner Canyon to Bear Spring in upper Big Casa Blanca Canyon. Another trail runs from the end of the road in Gardner Canyon to the headwaters of Big Casa Blanca Canyon. No trails exist from lower Big Casa Blanca Canyon into former Tarahumara frog habitat due to presence of a private inholding. Most of the recreational use in the area is in Gardner Canyon, including hiking, camping, and other dispersed recreational activities. Many of the visitors to Gardner Canyon come to hike the trail from the end of Forest Road 785 to the top of Mount Wrightson. Big Casa Blanca, Adobe, and Walker canyons receive limited recreational use from dispersed camping and hunting. Former Tarahumara frog habitat in Big Casa Blanca Canyon lies within the Mount Wrightson Wilderness Area.

Big Casa Blanca and Walker canyons are part of the Temporal grazing allotment, Adobe Canyon is in the Fort allotment, and Gardner Canyon is in the Gardner Canyon allotment. Cattle may not be able to physically access the best Tarahumara frog habitats in Big Casa Blanca Canyon due to rough terrain. In nearly 30 years of visiting the canyon, S. Hale (pers. comm. 2000) has never observed heavy grazing in the canyon, or other significant effects of livestock grazing on frog habitats. The Temporal allotment is permitted for 350 cow/calf and is operated as a seven pasture rotation system. Ten percent of the allotment is in high range condition, 80 percent is moderately high, and 10 percent is moderately low. Range condition is static. Eighty-six percent of the allotment is in satisfactory soil condition. The Fort allotment is permitted for 85 cow/calf and is operated as a three pasture rotation system. Twenty-five percent of the allotment is in high range condition and 75 percent is in moderately high condition; range condition trend is static. Fifty-five percent of the allotment is in satisfactory soil condition. The Gardner Canyon allotment is permitted for 211 cow/calf from June 1 to October 31 and December 1 to February 28 of each year. An additional 20 cow/calf are permitted through a private land permit during the same periods. Ten percent of the allotment is in moderately high range condition with an upward trend, and the remaining 90 percent is in moderately high condition with a static trend. Eighty percent of the allotment is in satisfactory soil condition (Coronado National Forest 2002). In a biological opinion assessing effects to listed species on the Coronado National Forest (U.S. Fish and Wildlife Service 2002), AESO found that proposed livestock grazing on the Temporal, Fort, and Gardner



Canyon allotments was not likely to jeopardize the continued existence of threatened or endangered species in the area.

The Mexican spotted owl occurs in the Big Casa Blanca Canyon area in the Big Casa Blanca PAC (050210) and Baldy Springs PAC (050203). The Big Casa Blanca PAC includes the upper reaches of Big Casa Blanca Canyon above 5960 feet. In that canyon, Tarahumara frogs occurred most commonly from 4890 to 5610 feet elevation, below the PAC, but were also found occasionally from elevation 6400 to 6790 feet within the PAC. Releases and potentially monitoring would occur along Big Casa Blanca Canyon in the PAC at least to elevation 6790 feet. Baldy Spring PAC lies at and to the east of Mount Wrightson, including a portion of Gardner Canyon above 6440 feet elevation, which begins about 1.1 mile west of Tunnel Spring. No releases of Tarahumara frogs are planned in Gardner Canyon; however, Tarahumara frogs were occasionally observed or collected historically from that canyon between elevation 5800 to 6460 feet. If the introductions are successful, frogs could colonize their former habitats in Gardner Canyon, and monitoring for Tarahumara frogs in the lower reaches of Gardner Canyon within the PAC would occur.

Lesser long-nosed bats (*Leptonycteris curasoae yerbabuenae*) likely forage in the area, and jaguar (*Panthera onca*) may on occasion pass through Big Casa Blanca Canyon or adjacent areas, although neither species have been documented to occur in former Tarahumara frog habitats. Chiricahua leopard frogs occurred historically in Big Casa Blanca and Adobe canyons, but have not been observed in these canyons since 1979. Chiricahua leopard frogs occur currently downstream of former Tarahumara frog habitats in Gardner Canyon. In a November 2003 biological opinion, the Fish and Wildlife Service's Southwest Regional Office found that the proposal to re-establish Tarahumara frogs into Sycamore and Big Casa Blanca canyons was not likely to jeopardize the continued existence of the Chiricahua leopard frog, Sonora chub, or Mexican spotted owl, and was not likely to result in destruction or adverse modification of critical habitat designated for the Sonora chub.

### **Sycamore Canyon Area**

Tarahumara frogs occurred historically in Sycamore Canyon from the Hank and Yank Spring box south of Ruby Road for at least 1.8 mile downstream and also in the first 0.6 mile or more upstream in Penasco Canyon from its confluence with Sycamore Canyon. Hale and May (1983) found that about 1.8-2.5 miles of suitable habitat existed in the 6.2 miles of canyon from Hank and Yank Spring to the international boundary. Because of the aquatic nature of the Tarahumara frog and its subsequent low dispersal potential, re-established frogs are probably unlikely to disperse in the foreseeable future outside of this area.

Sycamore Canyon is accessed by driving approximately 17.5 miles west of Interstate 19 on Ruby Road. All former habitats of the Tarahumara frog in the Sycamore Canyon area are on lands managed by the Coronado National Forest. The perennial stream, which flows south, and associated riparian corridor, support an extremely diverse plant and animal community; part of

which has been designated the Gooding Research Natural Area. From about an eighth of a mile downstream of Hank and Yank Spring to the border, the canyon runs through the Pajarita Wilderness Area. At nearby Ruby, Arizona, mean annual precipitation is 18.95 inches, of which 47 percent falls during the summer monsoon months of July and August. Monthly mean maximum temperatures vary from 91.8 in July to 59.6° F in January. Mean monthly minimum temperatures range from 66.9 in July to 35.7° F in January (Western Regional Climate Center 2003). Over 625 species of plants have been identified in Sycamore Canyon, many of which are rare or of limited distribution. Over 130 species of birds have been identified as frequent visitors to the canyon, including species such as elegant trogon, rose-throated becard, and varied bunting, which attract many birdwatchers. Many species of plants and animals occur in Sycamore Canyon that have limited distributions in the United States. Many of these species are more common in Mexico. The riparian corridor supports woodlands of cottonwood, willow, sycamore, Arizona ash, and other species. Upland plant communities include oak and mesquite grassland near Ruby Road to a semi-desert grassland community near the border that includes many Sonoran Desert species, including saguaros.

A hiking trail begins at the Hank and Yank ruins. Remnants of an old adobe wall are all that is left of a Civil War-era homestead that was pioneered by Hank Hewitt and Yank Bartlett. The trail itself exists only in a few places along the floor of Sycamore Canyon. More generally it just follows the stream, crossing it and recrossing it over stepping stones and gravel bars. As the canyon meanders toward Mexico, pinnacles and sheer rock cliffs that form the canyon walls occasionally crowd the stream. Pools in the inner reaches of the canyon hold water year-round. About 5 miles downstream from the trailhead, the canyon opens up and crosses a barbed wire fence that marks the Arizona/Mexico border. At the border some hikers elect to turn east and travel along a little-used pathway called the Border Trail. This foot and horse path provides access for maintenance of the international boundary fence. It leads over grassy foothills of the Pajaritos to the end of the Summit Motorway, Forest Road 39A, a 4-wheel drive route from Ruby Road. Recreational uses in Sycamore Canyon are birding (about 90 percent of the use there) and limited dispersed camping and hunting (D. Sebesta, Coronado National Forest, Tucson). In the first mile or so below Ruby Road, Sycamore Canyon receives considerable public use in the form of hikers and bathers (many people swim in a large tinaja in the first mile below Ruby Road). The canyon is sometimes used by smugglers who carry drugs into the United States on foot.

Former habitats of the Tarahumara frog in the Sycamore Canyon area are part of the Coronado National Forest's Bear Valley livestock allotment. However, a riparian pasture has been developed that excludes livestock from former Tarahumara frog habitats. Trespass cattle rarely gain access to the enclosure. Permitted use on the Bear Valley allotment is 350 cow/calf, and the grazing system is deferred/rest rotation. A 1997 range condition analysis indicated most of the allotment is in good range condition. Soil quality conditions are satisfactory on 75 percent of the Sycamore Canyon watershed (Coronado National Forest 2002). In a biological opinion assessing effects to listed species occurring in Sycamore Canyon on the Bear Valley allotment (U.S. Fish and Wildlife Service 2002), AESO found that proposed livestock grazing was not likely to jeopardize the continued existence of the Sonora chub, Chiricahua leopard frog, and lesser long-

nosed bat. AESO concurred with the Coronado's determination that the grazing was not likely to adversely affect the Gila topminnow (*Poeciliopsis occidentalis occidentalis*), Mexican spotted owl, or jaguar.

At least three species on the Federal threatened or endangered species lists occur in former habitats of the Tarahumara frog in Sycamore Canyon, including the Chiricahua leopard frog, Sonora chub, and Mexican spotted owl, all of which are listed as threatened. Critical habitat is designated for the Sonora chub in Sycamore Canyon, extending downstream from and including Hank and Yank Spring, to the International border. Also designated is the lower 1.2 mile of Penasco Creek, and the lower 0.25 mile of an unnamed stream entering Sycamore Creek from the west, about 1.5 mile downstream from Yank Spring. A PAC was designated for the Mexican spotted owl in Sycamore Canyon (PAC 050209). PACs are at least 600 acres drawn around sites where an owl(s) was found after 1988. The recovery plan for the owl recommends special management in PACs to protect owls and their habitat (U.S. Fish and Wildlife Service 1995). Lesser long-nosed bats (endangered) have not been documented in the canyon, but likely forage in the area. A jaguar was documented in nearby California Gulch in December 2001; these rare cats probably occasionally pass through Sycamore Canyon. Releases and monitoring of Tarahumara frogs are proposed in the habitats of these listed species, including critical habitat for the Sonora chub. In a November 2003 biological opinion, the Fish and Wildlife Service's Southwest Regional Office found that the proposal to re-establish Tarahumara frogs into Sycamore and Big Casa Blanca canyons was not likely to jeopardize the continued existence of the Chiricahua leopard frog, Sonora chub, or Mexican spotted owl, and was not likely to result in destruction or adverse modification of critical habitat designated for the Sonora chub.

## **Section V: ENVIRONMENTAL CONSEQUENCES**

Effects of the proposed and no action alternatives are summarized in Table 1. The no action alternative would likely continue current conditions under which the Tarahumara frog is absent from the Big Casa Blanca and Sycamore canyon areas. AGFD could pursue re-establishment without Federal action by the U.S. Fish and Wildlife Service. Such action would not be subject to NEPA; however, AGFD's procedures for re-establishment projects (Johnson and Glinski 1989) provides for public input. The following major concerns and issues related to effects of the alternatives emerged from scoping conducted by AGFD and summarized above under Section 1, part "D": 1) how would the alternatives affect land use, such as livestock grazing and mining? 2) Would the expenditure of public funds needed to implement re-establishment be a wise and prudent use of such funds, or could the funds be better used for other purposes? 3) How would re-establishment of the Tarahumara frog affect threatened and endangered species and their habitats? These and other likely effects on the human environment resulting from implementation of the alternatives are described herein. Important to our analysis are effects of proposed releases and monitoring activities on threatened or endangered species in the Big Casa Blanca and Sycamore canyon areas. Minor effects would also occur to recreational uses and opportunities in these areas, including the Pajarita and Mount Wrightson wilderness areas, and re-establishment would have an economic cost. We expect no effects to air or water quality, water quantity,

cultural and historical resources, visual resources, soils, or geology. Collection of Tarahumara frogs in Sonora is not anticipated to adversely affect populations there, because we will collect only a small number of frogs, tadpoles, or portions of egg masses from any one site, and we will focus our collections on eggs - which typically experience high rates of mortality in the wild (thus most would die in the wild before reaching reproductive maturity).

## Land use

### No Action Alternative

Under no-action, the Fish and Wildlife Service would not participate in re-establishment of the Tarahumara frog in Big Casa Blanca or Sycamore canyons. This would result in no changes in land management. If the AGFD proceeded with re-establishment under this alternative, the effects on land management would be as described under the Proposed Alternative.

### Proposed Alternative

The proposed alternative would involve re-establishment of a native species that is currently not protected by the ESA or other legislation that would require or imply that significant changes in land management would be needed to support the re-establishment or protect the frogs after they are released and established. In the unlikely event that the status of the Tarahumara frog deteriorated significantly and the species was listed in the future as threatened or endangered, provisions of the ESA prohibiting “take” (Section 9), requiring consultations for Federal actions that may affect the frog [Section 7(a)(2)], and others would apply. However, we believe effects from such regulations would be few. In a June 9, 1995, letter from the Acting Forest Supervisor for the Coronado National Forest to Terry Johnson, Nongame Branch Chief, AGFD, the Coronado Forest stated “It appears that there will be no conflicts between Tarahumara frog conservation and any of the Forest land management practices that are being carried out in accordance with the LRMP (Land and Resource Management Plan) standards and guidelines.” We discuss here land uses that could potentially be affected.

#### 1. Livestock grazing activities

A meeting was held April 17, 2003, in Nogales among landowners and livestock grazing permittees, and personnel of the Nogales Ranger District of the Coronado National Forest; U.S. Fish and Wildlife Service; and Arizona Game and Fish Department, Nongame Branch, Phoenix; to discuss the re-establishment proposal. Ranchers in attendance wanted to know the likelihood that the Tarahumara frog would be listed as threatened or endangered in the future, and if it was listed, what the effect might be on their ranching operations. In a follow up letter dated May 7, 2003, we stated the status of the frog did not currently warrant designating the species as a candidate for listing, and that re-establishment would make it even less likely that listing would be needed.

However, the status of species can change and we cannot guarantee that the Tarahumara frog will not need protection under the ESA in the future.

The ecology of the Tarahumara frog and the nature of the livestock grazing activities that occur in the Big Casa Blanca and Sycamore canyon areas indicate little potential for conflict between ranching and the success of Tarahumara frog re-establishment. The frog was never found in the past on private or other non-Forest lands in the Big Casa Blanca or Sycamore canyon areas. Also, the Tarahumara frog is a highly aquatic frog that rarely strays far from water. As a result, if the re-establishments are successful, we do not expect Tarahumara frogs to migrate to or colonize any adjacent lands off-Forest. Thus, private landowners would not be burdened by any liability for take of a listed species, and would not face other requirements under the ESA on their private lands. If the species were to be listed, the Coronado National Forest would be required to consult with us on any of their activities, including Forest-authorized grazing activities, that may affect the frog.

In Sycamore Canyon, livestock are excluded from habitats expected to be occupied by Tarahumara frogs, and most of the Bear Valley allotment, which includes Sycamore Canyon, and its immediate watershed is in good range condition. Furthermore, soil quality conditions are satisfactory on 75 percent of the Sycamore Canyon watershed (Coronado National Forest 2002). Taken together, we anticipate that no additional restrictions would occur to livestock grazing activities in the Sycamore Canyon area if the Tarahumara frog were listed. Also, Chiricahua leopard frogs and Sonora chub, both aquatic listed species, occur in Sycamore Canyon. We believe that if management is adequate to maintain these species, then management is adequate to maintain populations of the Tarahumara frog. The results of our 2002 Section 7 consultation on these species found that these species were not likely to be jeopardized by livestock grazing on the Forest.

In Big Casa Blanca Canyon, the best populations of Tarahumara frogs were at the “Bathtub”, a steep, bedrock, slickrock part of the canyon that cattle probably cannot access, and if they do, they would do no damage to the habitat (there are no banklines to collapse or bankline vegetation for cattle to consume or trample). In other portions of Big Casa Blanca Canyon, cattle and Tarahumara frogs could occasionally come into contact. Cattle could occasionally trample a Tarahumara frog egg mass, young tadpoles, or young frogs. Banklines and bankline vegetation could be trampled or consumed, with some adverse effects to frog habitat. These effects would likely warrant Section 7 consultation for grazing activities in the Big Casa Blanca Canyon area. However, effects would occur outside of the best or core habitats for the frog, and thus would be much less than, for example, effects to the Chiricahua leopard frog in similar canyons (Chiricahua leopard frogs do not occur in Big Casa Blanca Canyon). As with the Bear Valley allotment, allotments in the Big Casa Blanca Canyon area generally exhibit good range and watershed condition. As a result, we believe changes in grazing activities would be unlikely to occur in the Big Casa Blanca Canyon area if the Tarahumara frog was listed under the ESA.

Cattle ranching and Tarahumara frogs coexisted for many decades in most localities in Arizona and Sonora, including Big Casa Blanca and Sycamore canyons. There is no reason to believe that they could not coexist again, or that effects of grazing would have more than minimal adverse effects on the frog or its habitat. Steve Hale, who has done most of the work on Tarahumara frogs and has 30 years of experience with the species, does not consider grazing to be a threat to the frog in Arizona. As a result, in the unlikely event that the Tarahumara frog is listed as threatened or endangered under the ESA, changes in livestock management would probably not be needed to either maintain populations or minimize incidental take.

## 2. Mining and Fire Management

If mining projects or fire management, including mechanical thinning, prescribed fire, or wildfire suppression, were proposed or conducted in the Big Casa Blanca and Sycamore canyon areas, the Forest Service would evaluate the effects of these proposed projects through the NEPA process, and propose, if needed and as appropriate, mitigation to reduce those effects to the Tarahumara frog. Mitigation would likely include actions to reduce watershed degradation and to maintain water quality. Because of the listed aquatic species in Sycamore Canyon, we would not anticipate that presence of the Tarahumara frog would precipitate additional mitigation specifically for this species. As with livestock grazing, if management of mining and fire is adequate for maintenance and recovery of Sonora chub and Chiricahua leopard frog populations, then management should be adequate for Tarahumara frogs, as well. In the unlikely event the Tarahumara frog were listed as threatened or endangered, the take prohibitions and consultation requirements of the ESA would apply. The Coronado would be required to consult with us on any mining or fire projects that may affect the frog. Additional measures could result from consultation that would minimize effects to the frog or its habitat.

## 3. Recreation and Wilderness Values

Re-establishment of Tarahumara frogs may enhance recreational experiences for those who value biodiversity. If successful, the Big Casa Blanca and Sycamore canyon areas would be the only places in the United States where the Tarahumara frog could be observed in the wild. Visitors to Sycamore Canyon, in particular, come to see a variety of birds, wildlife, and plants. Wilderness experience in the Pajarita and Mount Wrightson wilderness areas could be enhanced as well for some visitors that observe Tarahumara frogs. Monitoring and releases of frogs would occur relatively infrequently, and are unlikely to be observed by visitors to these wilderness areas. However, some wilderness visitors may, on occasion, experience reduced solitude due to these activities.

## Economics

### No Action Alternative

Under the no action alternative, the Fish and Wildlife Service would take no action to re-establish Tarahumara frogs into Arizona; thus no Federal funds would be expended beyond those already obligated in this and other planning processes.

### Proposed Alternative

Field *et al.* 2003 estimate the total costs of the Tarahumara frog re-establishment program for five years at \$178,700. We believe this is an accurate estimate; however, some of the costs have already been expended, wholly or in part, such as Section 7 compliance, NEPA compliance, and collection of stock (roughly \$8,400). We also anticipate that some of the work would be conducted by volunteers, such as releases and monitoring, and rearing of tadpoles, which would provide additional savings (see comment #7 in Field *et al.* 2003). Comments that funds proposed for re-establishment of Tarahumara frogs could be better used elsewhere were addressed by Field *et al.* (2003), who found that re-establishment of extirpated native biological diversity and recovery of species, either listed or in imminent threat of listing, are consistent with the AGFD mission and the Nongame and Endangered Wildlife subprogram narrative of Wildlife 2006. Re-establishment is also consistent with the Coronado National Forest's LRMP and "Arizona Wildlife and Fisheries Comprehensive Plan", and with mandates of the Fish and Wildlife Service, as described in the "Need for the Proposed Action" herein. The cost of re-establishment is small in comparison to the agencies' budgets: \$178,700 represents approximately 0.014 percent of the Fish and Wildlife Service's 2003 budget. This amount represents 0.74 percent of the 2003 budget of AGFD.

Some minor costs could be incurred due to mitigation for the frog that may be built into land-use proposals, such as any mining or fire projects in the Big Casa Blanca or Sycamore canyon areas. We expect these costs would be minor (see discussion of effects to land use, above) and the likelihood of a project being proposed that would affect the frog is probably low. Mitigation would likely occur in the Sycamore Canyon area with or without re-establishment, because of the presence of the Sonora chub and Chiricahua leopard frog, both listed under the ESA.

The benefits of re-establishment are difficult to quantify, in terms of dollars. Benefits are mostly intangible, e.g. enrichment of biodiversity; however, there will likely be some economic benefits as well, in terms of enhanced recreational opportunities. Many ecotourists visit southern Arizona to view rare birds and other borderland species. These recreationists expend considerable money in these nature-based pursuits. For instance, in 1991-1992, the economic impact on total industry output in the Sierra Vista area associated with nature-based visitors to Ramsey Canyon and the San Pedro River was roughly \$2.7 million per year (Crandall *et al.* 1992). The presence of Tarahumara frogs is expected to attract some visitors or enhance the experience of others, with associated economic benefits. We expect these beneficial impacts will offset, at least in part, economic costs associated with re-establishment and any resulting project-related mitigation that may result.

### Threatened and Endangered Species

### No Action Alternative

Under the no action alternative, the Fish and Wildlife Service would take no action to re-establish Tarahumara frogs in Arizona. The continued absence of the Tarahumara frogs at Big Casa Blanca Canyon would not affect Mexican spotted owls, lesser long-nosed bats, or other listed species that may occur in the area. The frog's continued absence is also likely to have no effects. The Tarahumara frog had no adverse impacts on the ecosystem, and we would not expect for any to occur in the future due to it being re-established back into this small part of its historical range. In Sycamore Canyon, Tarahumara frogs were likely predators of and were preyed upon by both Sonora chub and Chiricahua leopard frogs. Tarahumara frogs may have competed with Chiricahua leopard frogs as well (see discussion under Proposed Alternative, below). The interactions among these aquatic species were likely complex; however, Tarahumara frogs have not been observed in Sycamore Canyon since April 1974 (Hale and May 1983). Sonora chub and Chiricahua leopard frogs have persisted despite the absence of Tarahumara frogs for nearly 30 years, and there is no reason to believe their populations were significantly affected, or would be affected in the future, by the continued absence of the Tarahumara frog. If AGFD pursued re-establishment of the Tarahumara frog without the participation of the Fish and Wildlife Service, effects would be similar to that described below for the Proposed Alternative.

### Proposed Alternative

Effects of re-establishing Tarahumara frogs in the Big Casa Blanca and Sycamore canyon areas were described in the Fish and Wildlife Service's biological evaluation (U.S. Fish and Wildlife Service 2003a) and biological opinion (U.S. Fish and Wildlife Service 2003b) for this action. The following summarizes those documents.

Three species would be affected by the re-establishment project, including the Mexican spotted owl, Sonora chub, and Chiricahua leopard frog. The biological opinion concluded that the proposed re-establishment is not likely to jeopardize the continued existence of these species, and is not likely to result in the destruction or adverse modification of critical habitat designated for the Sonora chub in the Sycamore Canyon area. Effects to listed species and their habitats are expected to be few and are mitigated or minimized by conservation measures committed to as part of the proposed alternative.

#### 1. Mexican spotted owl

As discussed in the Affected Environment, the Mexican spotted owl occurs in the area of the proposed alternative in three PACs, including the Sycamore Canyon PAC, Big Casa Blanca PAC, and Baldy Springs PAC. The Sycamore Canyon PAC extends along Sycamore Canyon and its tributaries. Under the proposed alternative, release and monitoring of Tarahumara frogs would occur throughout the reach of Sycamore Canyon that occurs in the PAC. Tributaries in the PAC may be periodically explored by monitors. Releases and potentially monitoring would occur along Big Casa Blanca Canyon in the Big Casa Blanca PAC at least to elevation 6790 feet. No



releases of Tarahumara frogs are planned in the Baldy Spring PAC, but if the introductions are successful, frogs could reinvade their former habitats in Gardner Canyon, and monitoring for Tarahumara frogs in the lower reaches of Gardner Canyon within the PAC would occur.

The occupancy histories of the three PACs are summarized in Table 2. No information is available for 2001-2003, but before that time owls were usually present when the PACs were monitored. However, owls were found only once during monitoring from 1996-2000 in the Sycamore Canyon PAC. Owls were last detected in all three PACs in 1999. None of the birds in the three PACs is known to have nested successfully since 1994, when two young were produced in the Big Casa Blanca PAC. Based on prior occupancy it is likely that owls will be present in one or more of the PACs during releases and monitoring of Tarahumara frogs. Birds are most likely to occur in the Baldy Spring and Big Casa Blanca PACs, which have most consistently yielded birds during monitoring.

The only likely effect of the re-establishment program on the Mexican spotted owl is disturbance of owls due to human activities associated with the project, including carrying and releasing frogs/tadpoles into the canyons, and subsequent monitoring of the releases. The effects of such activities should be similar to the effects of recreational hikers, backpackers, and others walking through these canyons. The biological opinion and evaluation reviewed the literature on effects of recreational hikers on Mexican spotted owls. The most comprehensive studies have been conducted recently by Swarthout and Steidl (2003, 2001). In the first of those studies, the authors examined flush response of Mexican spotted owls to recreationists, and found that if hikers are excluded from a 79-foot radius around roost sites that 95 percent of owl flush responses would be eliminated. At national parks in Utah, Swarthout and Steidl (2003) examined behavioral responses of nesting Mexican spotted owls to individual hikers that passed within 36-210 feet of active nests every 15 minutes. Among various behavioral changes observed during treatments, females and males increased the frequency of contact vocalizations by 58 and 534 percent, respectively. Female owls decreased the amount of time they handled prey by 57 percent and decreased the amount of time they performed daytime maintenance behaviors by 30 percent. Swarthout and Steidl (2003) suggest that a 57 percent decrease in prey handling by female owls may be indicative of a potentially consequential reduction in energy intake. The sensitivity of females to hikers is especially important because females attend the nests almost exclusively, and nestling survival depends largely on female behavior. Predation and starvation of nestlings are the most common sources of nestling mortality (Forsman *et al.* 1984, Ganey *et al.* 1998), thus reduced prey handling time could affect nestling survival (Swarthout and Steidl 2003). Swarthout and Steidl (2003) suggest that restrictions on hiking intensity near nests should be considered on a case-by-case basis, but should probably only be implemented in canyons with use levels approximating or exceeding the use in their study (>48 hiking groups per day).

Swarthout and Steidl (2003) evaluated effects of diurnal hikers on owl behavior. Some of the frog monitoring work may be conducted at night, which could increase sensitivity of or responses by nesting owls. No monitoring or releases would be conducted within 0.25 mile of any nest during the nesting season. However, not all nests are located each year, so our activities could

potentially occur near nests that have not been detected by surveys. The greatest activity will occur during releases when teams of workers could potentially hike through a canyon multiple times during a day while carrying groups of tadpoles and frogs; however, use is not expected to exceed about 10 passes by groups of hikers per day. No releases would occur in, nor would hikers carrying frogs and tadpoles pass through, PACs in the Santa Rita Mountains. Monitors will occur over a greater area than releases; including all of the PACs in the action area (Big Casa Blanca, Baldy Springs, and Sycamore Canyon PACs); however, monitors would likely only make two passes by any nest sites (once hiking up a canyon, and once returning) during a day. Based on the work by Swarthout and Steidl (2001, 2003), these levels of activity should cause minimal disturbance to nesting owls.

Other effects to owls could occur through habitat disturbance, although we believe such effects would be very limited. Removal of living vegetation affects the habitat and food sources of small mammals (Hammit and Cole 1987) that comprise owl prey items. In addition, hikers may unintentionally start fires, for instance with discarded cigarettes, which could have a devastating effect on Mexican spotted owl habitat. Trampling of some streamside vegetation would likely occur during releases and monitoring, because field workers, particularly those doing monitoring, would often be off-trail. However, these effects would be short term and localized; we expect no long-term changes to riparian communities from our work. No campfires would be built, and workers would not smoke during releases or monitoring of frogs.

## 2. Sonora chub

The majority of the extant range and habitat of the Sonora chub in the United States occurs in Sycamore/Penasco canyons downstream of Ruby Road within the area where releases and monitoring of Tarahumara frogs would occur. Sonora chub have been able to survive in this watershed by expanding into riffles, runs, and pools during wet periods, and then shrinking back to deep pools as the stream dries. On an individual basis, a substantial number of Sonora chub die when they become trapped in habitats that do not sustain perennial water during arid periods (Carpenter and Maughan 1993). Recolonization is dependent on individuals that survive dry periods. This species has an amazing capacity for reproduction and recruitment as its habitat expands; it can seemingly explode from a small number of individuals occupying newly-wetted habitats in just a few weeks or months. The capability of the population to increase by several orders of magnitude within a few months is most likely an adaptation to the harsh climate and intermittent nature of its habitat, which has allowed the Sonora chub to survive to the present (Bell 1984).

Threats to the species in Sycamore Canyon include potential watershed degradation and accompanying siltation or flooding, as well as water quality problems due to livestock grazing, roads, and mining; potential introduction of nonnative fishes that could compete with or prey upon Sonora chub; and parasites or pathogens that may be introduced with nonnative fishes.

Effects could potentially occur to Sonora chub in Sycamore and Penasco canyons due to predation by Tarahumara frogs and monitoring of released frogs. Zweifel (1955) found remains of several Sonora chub in the stomachs of Tarahumara frogs collected in Arizona. Thus, we expect that Sonora chub would be preyed upon by Tarahumara frogs, if the re-establishment project moves forward and is successful. Levels of predation are not possible to assess; however, historically Tarahumara frogs and Sonora chub coexisted in the Sycamore and Penasco canyon areas, and we have no reason to believe they cannot coexist again. Sonora chub have not been documented eating Tarahumara frogs; however, they are opportunistic feeders (Minckley 1973) and would be expected to prey upon small tadpoles. Hale (2001) suggested a large chub (*Gilia* sp.) may have eliminated Tarahumara frogs from Arroyo el Portrero in southern Sonora.

Field workers, particularly those monitoring the releases, would need to walk along stream banks and occasionally in the water to locate frogs. Such activity could cause localized destabilized banks, increased turbidity, and potentially result in trampling of eggs or small fish. However, most work would occur from the banklines, and Tarahumara frogs are expected to be most abundant in bedrock plunge pools that are resistant to bank damage or increased turbidity. We expect that any effects to Sonora chub critical habitat would be minor, localized, and temporary. Sonora chub could also be unintentionally dip-netted during sampling for frogs. As part of our proposed action, any Sonora chub unintentionally dip-netted would promptly be returned to the water unharmed. Dip-netting of Sonora chub would only occur if permitted by a section 10(a)(1)(A) permit from the Fish and Wildlife Service. Any such dip-netting would occur in compliance with any terms and conditions of that permit.

### 3. Chiricahua leopard frog

Chiricahua leopard frogs are currently known to occur at Sycamore Canyon from Hank and Yank Spring probably nearly to the international boundary (although they are often most common in the first mile or two downstream of the spring). Frogs are often present at a livestock tank, Hank and Yank Tank, in a tributary of Sycamore Canyon to the east of Hank and Yank Spring, which is probably important in contributing frogs to Sycamore Canyon. In the vicinity of Big Casa Blanca Canyon in the Santa Rita Mountains, Chiricahua leopard frogs are known to occur in Gardner and adjacent Cave and Fish canyons about 2 miles downstream of Tunnel Spring, but currently do not occur in areas where re-establishment activities are proposed. Chiricahua leopard frogs occurred at one time in Big Casa Blanca and Adobe canyons, but have not been detected there since 1979. The extant populations in Sycamore Canyon and Gardner/Cave/Fish canyons inhabit stream courses and associated livestock tanks. The population in Sycamore Canyon has coexisted with chytridiomycosis since at least 1972 (Cashins and Davidson 2003).

Re-establishment currently would only affect Chiricahua leopard frogs in Sycamore Canyon. If Chiricahua leopard frogs reinvaded areas of Big Casa Blanca Canyon or adjacent canyons where Tarahumara frogs, releases, and monitoring may occur, they could be affected there as well. Where Chiricahua leopard frogs and Tarahumara frogs occur together, they may compete and prey upon each other. Although neither the Chiricahua leopard frog nor the Tarahuamara frog

have been documented eating other frogs, both eat a wide variety of prey items (Sredl and Jennings *in press*, Rorabaugh and Hale *in press*) and adult frogs would likely eat smaller frogs. Thus, re-establishment of Tarahumara frogs could result in elevated predation of metamorph or juvenile Chiricahua leopard frogs, and their tadpoles. On the other hand, small Tarahumara frogs would provide additional forage for Chiricahua leopard frogs. Tadpoles of these species are primarily herbivorous (Sredl and Jennings *in press*, Rorabaugh and Hale *in press*), thus tadpoles may compete for forage resources, if such resources are limiting. Although these effects between the frogs species may occur, Chiricahua leopard frogs and Tarahumara frogs occurred together historically in Arizona, and we have no reason to believe they could not again both maintain populations in the Sycamore Canyon area.

Monitoring of Tarahumara frogs would be likely to result in occasional dip-netting or flushing of Chiricahua leopard frogs. Tarahumara and Chiricahua leopard frogs would probably jump into the water as field workers walk along banklines searching for frogs. Some potential exists for tadpoles and frogs to be injured or killed during dip-netting; however, we have dip-netted many leopard frogs and tadpoles without any apparent capture-related injury or mortality. As part of our proposed alternative, any Chiricahua leopard frogs or tadpoles unintentionally dip-netted would promptly be returned to the water unharmed. We do not anticipate adverse effects to frogs that jump into the water in response to periodic monitoring and frog releases. Dip-netting of Chiricahua leopard frogs and tadpoles would only occur if permitted by a section 10(a)(1)(A) permit from the Fish and Wildlife Service. Any such dip-netting would occur in compliance with any terms and conditions of that permit.

Rearing of Tarahumara frogs and tadpoles in captivity and then moving these animals to the wild could potentially introduce novel diseases or parasites to the re-establishment sites. These diseases or parasites could potentially be imported with animals from Sonora, or could be spread to animals in the rearing facilities or during transport. Chiricahua leopard frogs rescued from a drying stock tank on the Coconino National Forest and taken to the Arizona Sonora Desert Museum that appeared healthy when captured, later became symptomatic for chytridiomycosis and also had trematode infections (C. Ivanyi, pers. comm. 2003). If novel diseases were introduced to Chiricahua leopard frog populations, the results could range from virtually no effect to a dramatic population decline. For example, the proximate cause of some extirpations of Chiricahua leopard frog populations in New Mexico is thought to be chytridiomycosis (R. Jennings, pers. comm. 2001). At this time the only virulent disease known to be associated with die-offs of Chiricahua leopard frogs is chytridiomycosis. Chytridiomycosis is known to occur in Sycamore Canyon, thus unintentional introduction of this pathogen there should have no effect. Its presence in Big Casa Blanca Canyon and adjacent canyons is unknown. However, Tarahumara frogs will receive a disease screening prior to release. Disease prevention techniques may include use of a fungicide to reduce the likelihood of spreading chytridiomycosis. No diseased animals will knowingly be released (Field *et al.* 2003); however, there is still some potential of releasing diseased animals that could then affect Chiricahua leopard frogs. In the laboratory, Tarahumara frogs are very sensitive to chytridiomycosis and rapidly succumb to the disease (Rollins-Smith *et al.* 2002). Thus, the likelihood of not detecting Tarahumara frogs with

chytridiomycosis during disease screening is reduced. If chytridiomycosis was unintentionally introduced to Big Casa Blanca (assuming it is not present now), spread to extant Chiricahua leopard frog populations in Gardner, Fish, and Cave canyons would be contingent upon infected frogs moving among these canyons, or movement via some other vector. We believe the likelihood of introducing chytridiomycosis to Chiricahua leopard frog populations as a result of the proposed alternative is highly unlikely due to the disease screening and prevention measures that are part of the alternative, and the other considerations just discussed.

### Cumulative Impacts

The Council on Environmental Quality defines cumulative impacts as the incremental impact of multiple present and future actions with individually minor, but collectively significant, effects. Cumulative impacts can be concisely defined as the total effects of the multiple land uses and development, including their interrelationships, on the environment.

Most of the current land uses and developments in the Sycamore and Big Casa Blanca canyon areas were described in the “Affected Environment” herein. In the Sycamore Canyon area, these include dispersed recreation, livestock grazing (but not in former habitats of the Tarahumara frog), and illegal migrants and drug smugglers. In the Big Casa Blanca Canyon area, livestock grazing and limited dispersed recreation occurs. We are not aware of significant illegal migrant or drug smuggling in the Big Casa Blanca Canyon area. Both areas have limited unpaved road access into the edges or outskirts of the areas; and both include portions of designated wilderness areas, which strictly limit human impacts. None of the resources in the Big Casa Blanca or Sycamore Canyon areas would be expected to incur significant cumulative impacts from these activities or the alternatives described herein.

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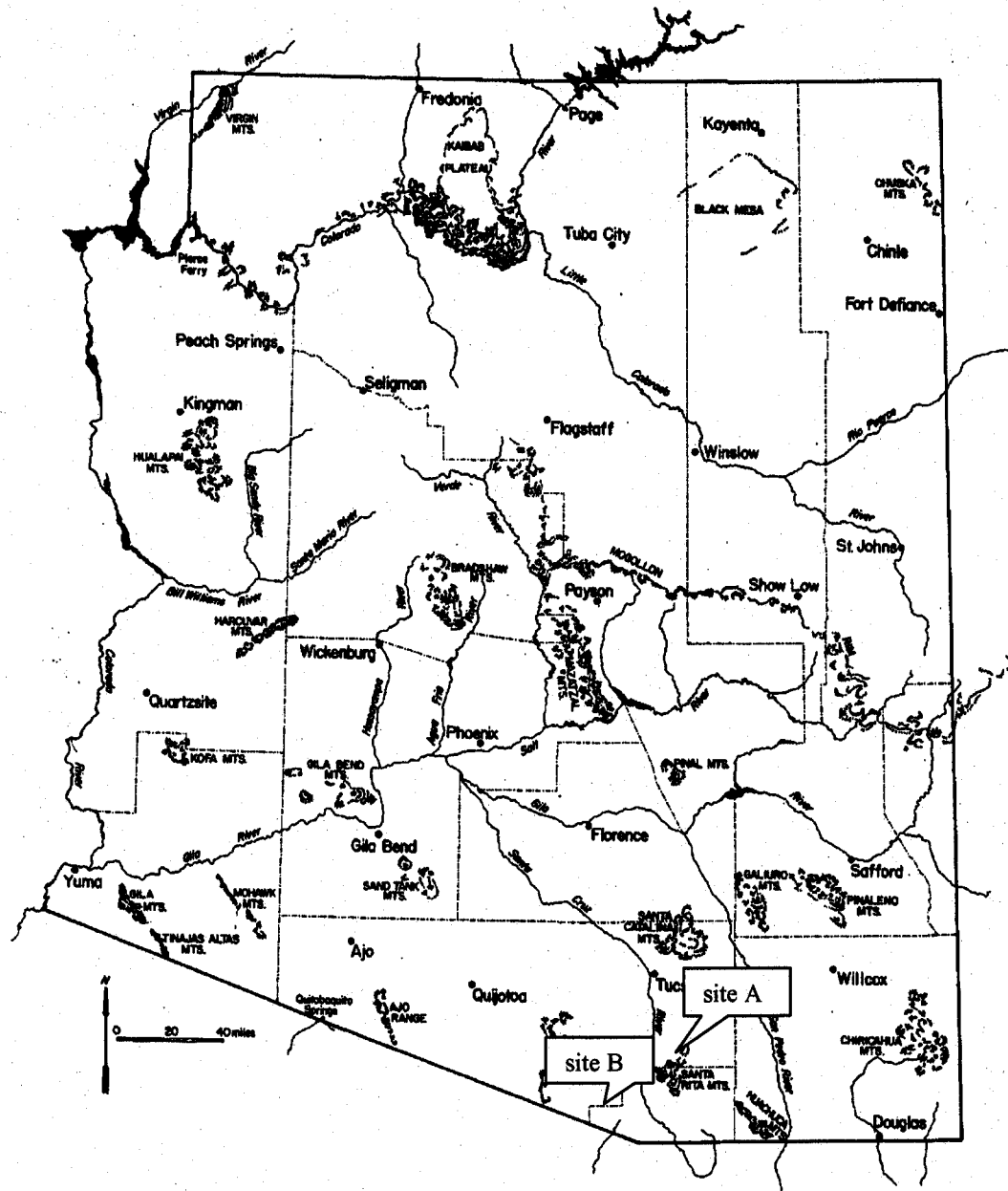
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**Figure 1.** Map of proposed re-establishment areas. Site A indicates Big Casa Blanca Canyon in the Santa Rita Mountains and site B indicates Sycamore Canyon in the Pajarito Mountains (from Field *et al.* 2003).

**Table 1.** Summary of impacts to environmental resources by alternative.

<b>Resources</b>	<b>No Action Alternative</b> (No participation by Fish and Wildlife Service in Tarahumara frog Re-establishment)	<b>Proposed Alternative</b> (Fish and Wildlife Service participation in Tarahumara frog re-establishment)
<b>Land Use</b>	No effects, or effects similar to proposed alternative, if AGFD pursues re-establishment without the participation of the Fish and Wildlife Service.	No or few effects in Sycamore Canyon area due to presence of other sensitive aquatic species with similar requirements. Minor effects to some land-use activities in Big Casa Blanca Canyon area. Minor positive and negative effects to wilderness values and recreational opportunities.

<b>Economics</b>	No effects, or effects similar to proposed alternative, if AGFD pursues re-establishment without the participation of the Fish and Wildlife Service.	Costs of re-establishment are relatively low, and benefits of the program include expected minor increase in expenditures by recreationists that could benefit local economies.
<b>Threatened and Endangered Species</b>	No effects, or effects similar to proposed alternative, if AGFD pursues re-establishment without the participation of the Fish and Wildlife Service.	Minor adverse effects to Mexican spotted owl, Sonora chub, and Chiricahua leopard frog; and critical habitat designated for the chub. Adverse effects are largely offset by conservation measures included as part of the proposed alternative.
<b>Tarahumara frog populations in Sonora</b>	No effects	No effects.
<b>Soils and Geology</b>	No effects	No effects
<b>Cultural and Historical Resources</b>	No effects	No effects
<b>Air Quality</b>	No effects	No effects
<b>Water Quality and Quantity</b>	No effects	No effects
<b>Visual</b>	No effects	No effects
<b>Cumulative Effects</b>	Minor effects to resources in the Big Casa Blanca or Sycamore Canyon areas due to cumulative impacts.	Minor effects to resources in the Big Casa Blanca or Sycamore Canyon areas due to cumulative impacts.

## Table 2

PAC Name	PAC #	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Baldy Spring	0502003	O,NU	NI	O,NN	O,NN	O,NU	O,NU	IM-NR	NI	NI	NF	NF	NI	NI	NI
Sycamore Canyon	0502009	NI	O,1Y	O,NN	O,2Y	P,NN	O,NU	NI	IM-NR	IM-NR	IM-NR	P	IM-IR	NI	NI
Big Casa Blanca	0502010	NI	NI	NI	NI	O,2Y	O,2Y	F,NN	M,NU	NI	NI	NF	NI	NI	NI

LEGEND

A Absence or unoccupied  
 F Female inferred or confirmed  
 IM-NR Informally monitored, no response or location  
 M Male inferred or confirmed  
 NA Nest abandoned  
 NF Nest failed  
 NI No Information  
 NN Non-nesting  
 NS No Survey  
 NU Nesting status undetermined  
 NY Nesting status undetermined, no known young produced  
 O Pair Occupancy inferred or confirmed  
 P Presence of a single owl inferred or confirmed, sex unknown  
 Y Number of young fledged  
 YD Number of young found dead